REAL TIME RIVE WATER QUALITY MONITORING AND CONTROL SYSTEM

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1. INTRODUCTION:

1.1. PROJECT OVERVIEW:

In this paper, we depict the design of Wireless Sensor Network (WSN) that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on. The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission, and processing. The clients can get ongoing water quality information from far away. Now a day's Internet of things (IoT) is an innovative technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations.

1.2. PROJECT PURPOSE:

The river water is bound to get polluted from various pollutants such as the urban waste water, agricultural waste and industrial waste, thus making it unusable for anthropogenic activities. The traditional manual technique that is under use is a very slow process. It requires staff to collect the water samples from the site and take them to the laboratory and then perform the analysis on various water parameters which is costly and time-consuming process. The timely information about water quality is thus unavailable to the people in the river basin area. This creates a perfect opportunity for swift real-time water quality check through analysis of water samples collected from the river. IoT is one of the ways with which real-time monitoring of water qualityof river can be done in quick time.

2. LITERATURE SURVEY:

2.1.EXITISING PROBLEM:

Water has become an increasingly important ingredient in the development process of all countries. Not only is safe drinking water essential for our well-being, but water is also a primary requisite for further agricultural, industrial and energy-related developments. Based on existing studies, four major water problems facing the world today are identified. These are the provision of safe drinking water; water requirements for further agricultural, hydroelectric and industrial developments; sustainability of water development projects; and development of water resources shared by two or more states. Both

the magnitude and nature of the problem areas are discussed. Four major strategic considerations, as they relate to the priority areas identified, are outlined. These include consideration of the multidimensionality of the problem; promotion of the efficient use of water; encouragement of better management of water resources systems; and application of research results to solve real-world problems.

2.2. REFERENCE:

➢K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

3. IDEATION & PORPOSED SOLUTION:

3.1. EMPATHY MAP CANVA:

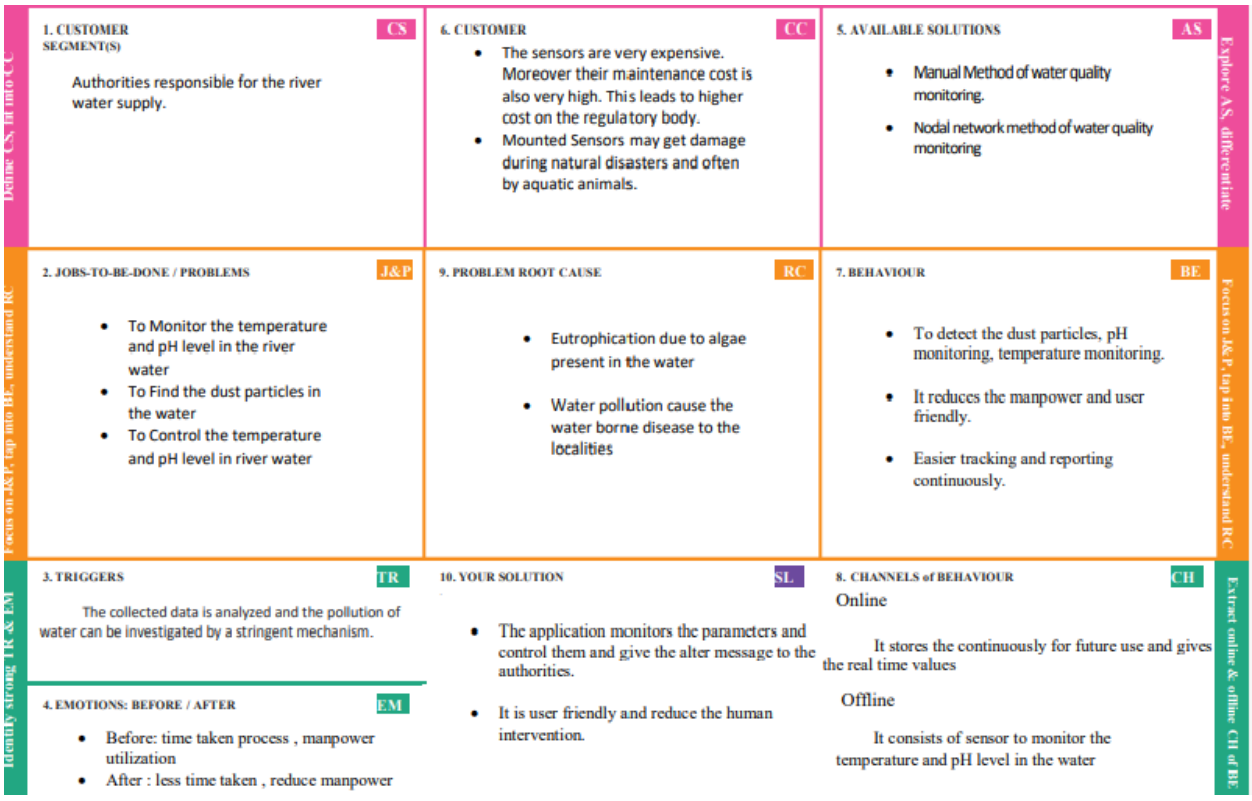
3.2. IDEATION AND BRAINSTORMING:

3.3. PROPOSED SOLUTION:

Proposed Solution Template:

S.NO	PARAMETER	DESCRIPTION
1.	Problem statement (problem to be solved)	Monitoring and controlling the quality of the river water
2.	Idea/ Solution description	Detecting the dust particles , Measure the pH and temperature and altering the authorities that water is not good
3.	Novelty/ Uniqueness	The quality parameters will track continuously with standard measurements.
4.	Social Impact / Customer Satisfaction	Localities will not suffered by poor quality of water by alerting them when the water quality is not good.
5.	Business model (revenue model)	Aeronsystems.com
6.	Scalability of the solution	Measuring of real time values and continuous monitoring helps in maintaining the quality of water

3.4. PROBLEM SOLUTION FIT:



4.REQUIREMENT ANALYSIS:

4.1. FUNCTIONAL REQUIREMENT:

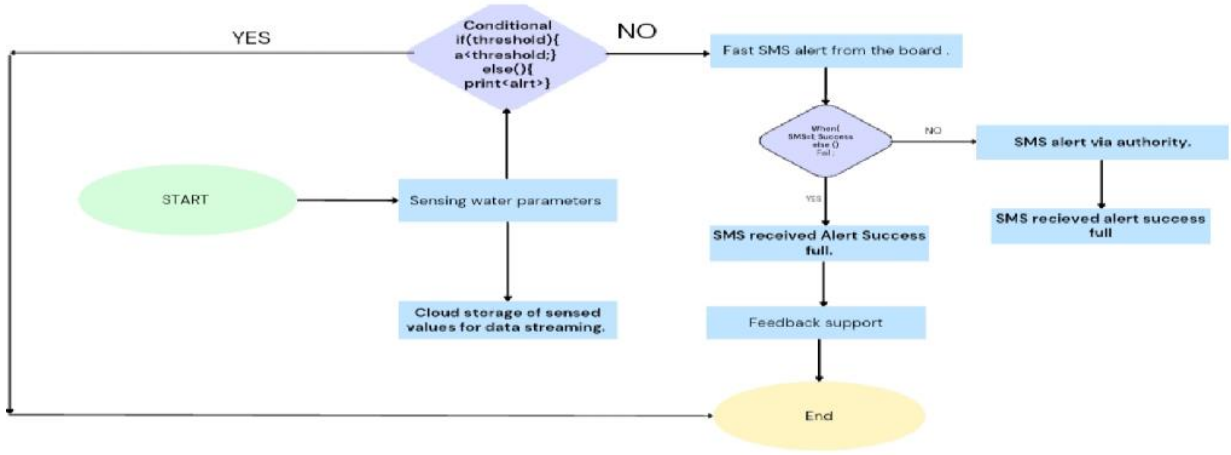
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User access	1.Accepting all the terms and conditions. 2.Confirmation of recaptcha.
FR-4	User mode	Online
FR-5	User alert	Alert SMS to the registered mobile number if the measured value crosses the threshold value.

4.2.NON-FUNCTIONAL REQUIREMENT:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	1.Ease and convenience usage 2.User- friendly 3.Easy to get into
NFR-2	**Security**	1.Accepting Terms and Conditions. 2.Confirmation via Email and OTP. 3.Confirmation via recaptcha. 4.Strong cryptography skills. 5.Software security architects also have experience with malware, intrusion detection and prevention and firewalls.
NFR-3	**Reliability**	1.System adequacy and system security. 2.Software operating without failure while in a specified environment over a set duration of time
NFR-4	**Performance**	1. Measuring water usage 2. Rapid performance 3.Quick to access

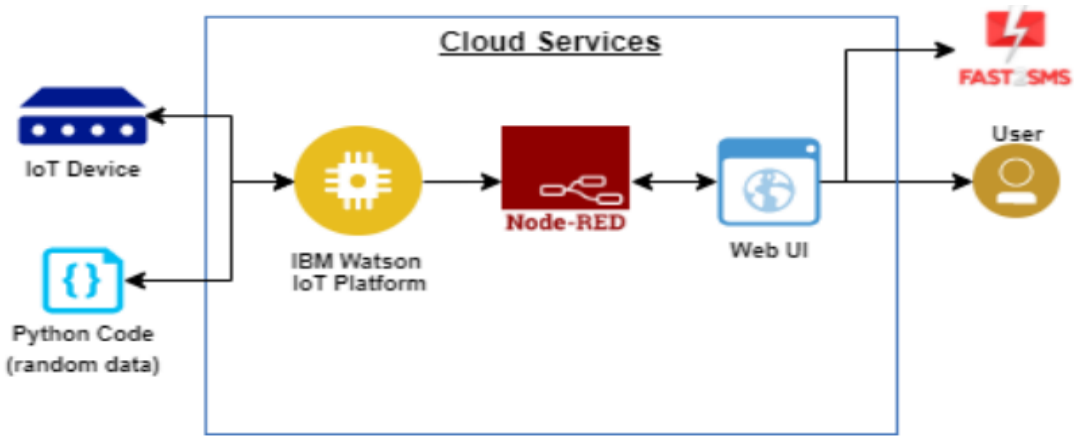
5.PROJECT DESIGN:

5.1.DATA FLOW DIAGRAMS:

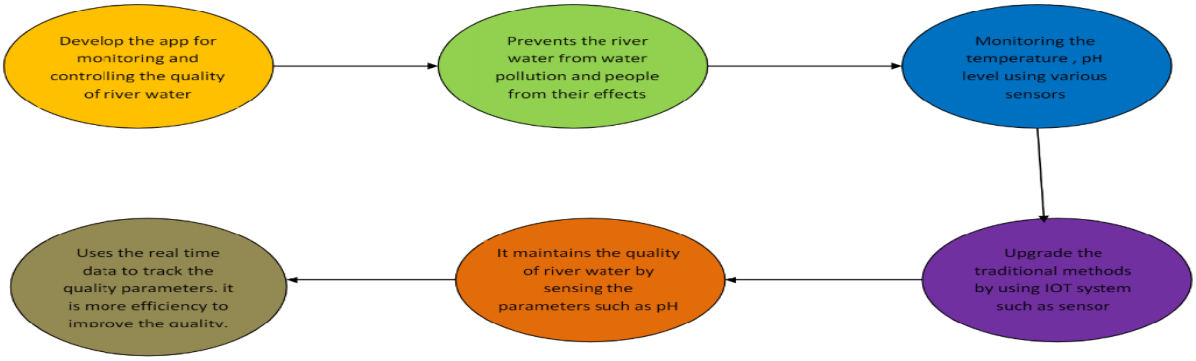


5.2. SOLUTION & TECHNICAL ARCHITECTRUE:

➢**Technical architecture:-**



➢**Solution architecture:-**



5.3.USER STORIES:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering email, password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmationemail once I have registered for the application	I can receive e confirmation email &click confirm	High	Sprint-2
		USN-3	As a user, I can register for the applicationthrough google	I can register & accessthe dashboard with google	High	Sprint-1
		USN-4	As a user, I can register for the applicationthrough Gmail	I can register through e hmail.	Medium	Sprint-2
	Login	USN-5	As a user, I can log into the application byentering email, password & captcha	I can receive logincredentials.	High	Sprint-1
	Interface	USN-6	As a user, the interface should be user-friendlymanner	I can able to accesseasily.	Medium	Sprint-1
Customer (Webuser)	dashboard	USN-7	As a user, I can access the specific info(phvalue, temp, humidity, quality).	I can able to know thequality of the water.	High	Sprint-1
Customer (input)	View manner	USN-8	As a user, I can view data in visualrepresentation manner(graph)	I can easily understandby visuals.	High	Sprint-3
	Taste	USN-9	As a user , I can able to view the quality(salty) ofthe water	I can easily know whether itis salty or not	High	Sprint-3
	Colour visiblity	USN-10	As a user , I can able predict the water colour	I can easily know thecondition by colour	High	Sprint-3
Administrator	Risk tolerant	USN-11	An administrator who Is handling the system should update and take care of the application.	Admin should monitor therecords properly.	Medium	Sprint-4

6.PROJECT PLANNING & SCHEDULING:

6.1.SPRINT PLANNING & ESTIMATION:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering email, password, and confirming my password.	2	High	Abirami, sheebha, sneka, sudha
Sprint-2		USN-2	As a user, I will receive a confirmationemail once I have registered for the application	1	High	Abirami, sheebha, sneka, sudha
Sprint-1		USN-3	As a user, I can register for the applicationthrough google	2	Low	Abirami, sheebha, sneka, sudha
Sprint-2		USN-4	As a user, I can register for the applicationthrough Gmail	2	Medium	Abirami, sheebha, sneka, sudha
Sprint-1	Login	USN-5	As a user, I can log into the application byentering email, password & captcha	1	High	Abirami, sheebha, sneka, sudha
Sprint-1	Interface	USN-6	As a user, the interface should be user-friendlymanner	2	Medium	Abirami, sheebha, sneka, sudha
Sprint-1	dashboard	USN-7	As a user, I can access the specific info(phvalue, temp, humidity, quality).	2	High	Abirami, sheebha, sneka, sudha

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-3	View manner	USN-8	As a user, I can view data in visualrepresentation manner(graph)	1	High	Abirami, sheebha, sneka, sudha
Sprint-3	Taste	USN-9	As a user , I can able to view the quality(salty) ofthe water	1	High	Abirami, sheebha, sneka, sudha
Sprint 3	Colour visiblity	USN 10	As a user , I can able predict the water colour	2	High	Abirami, sheebha, sneka, sudha
Sprint-4	Risk tolerant	USN-11	An administrator who is handling the system should update and take care of the application.	2	Medium	Abirami, sheebha, sneka, sudha

6.2.SPRINT DELIVERY SCHEDULING:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

7.CODING AND SOLUTIONING:

7.1. FEATURES:

➢ SPRINT 1 - Python Code

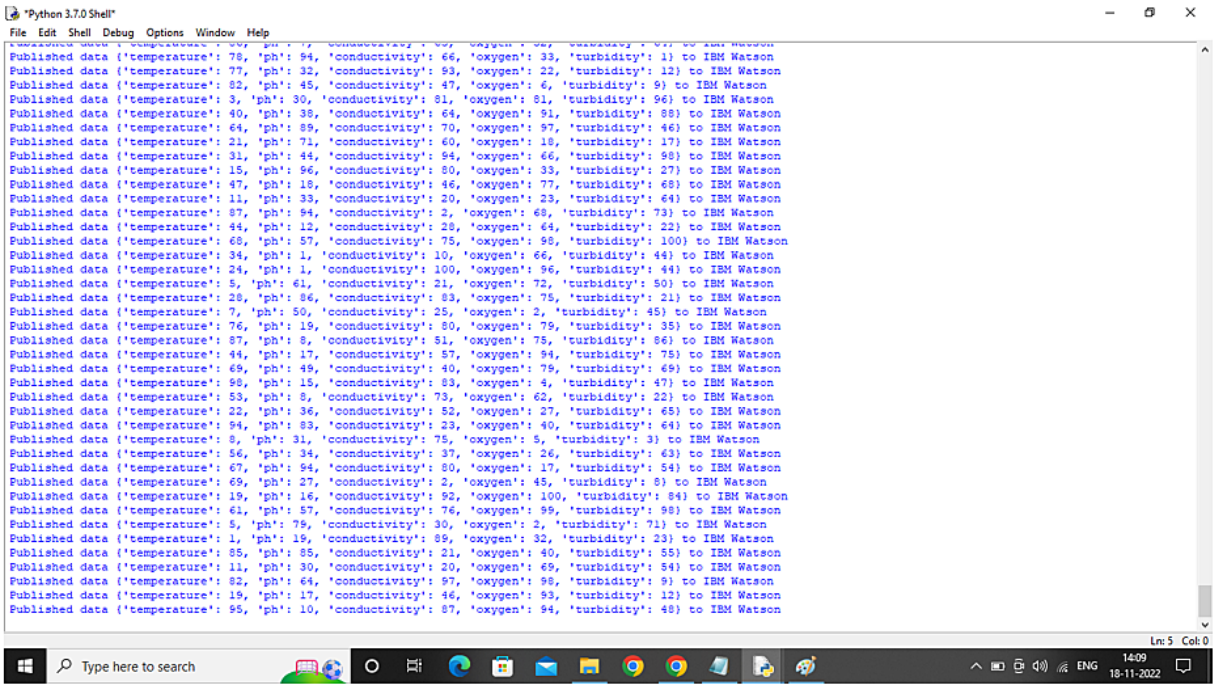
Code to get sensor values:

```
import random

import time

import sys

import ibmiotf.application

import ibmiotf.device
```

```
# Provide your IBM Watson Device Credentials
organization = "l0cmny"  # repalce it with organization ID
deviceType = "raspberrypi"  # replace it with device type
deviceId = "ABCD"  # repalce with device id
authMethod = "token"
authToken = "12345678"  # repalce with token


def myCommandCallback(cmd):
   print("Command received: %s" % cmd.data['command'])
   status=cmd.data['command']
   if status == 'motoron':
      print("MOTOR ON")
   elif status == 'motoroff':
      print("MOTOR OFF")


try:
   deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":
authMethod,
                    "auth-token": authToken}
   deviceCli = ibmiotf.device.Client(deviceOptions)
# ..............................................
except Exception as e:
   print("Caught exception connecting device: %s" % str(e))
   sys.exit()
deviceCli.connect()
while True:
```

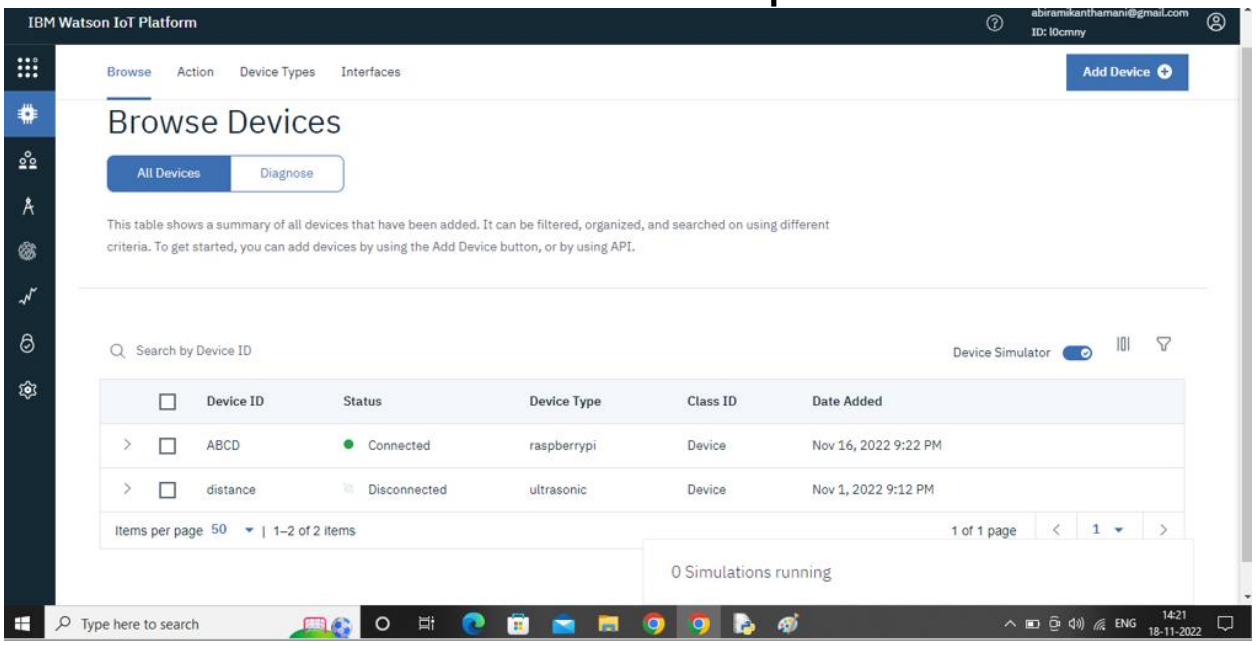
```
    pH = random.randint(0,100)
    conductivity = random.randint(0,100)
    T = random.randint(0,100)
    oxygen = random.randint(0,100)
    turbidity = random.randint(0,100)

    # Send Temperature & Humidity to IBM Watson
    data = {'temperature':
T,'ph':pH,'conductivity':conductivity,'oxygen':oxygen,"turbidity":turbidity}

    # print data
    def myOnPublishCallback():
        print("Published data",data, "to IBM Watson")
    success = deviceCli.publishEvent("event", "json", data, 0, myOnPublishCallback)
    if not success:
        print("Not connected to IoTF")
    time.sleep(5)
    deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

Sprint 1 - ouput:

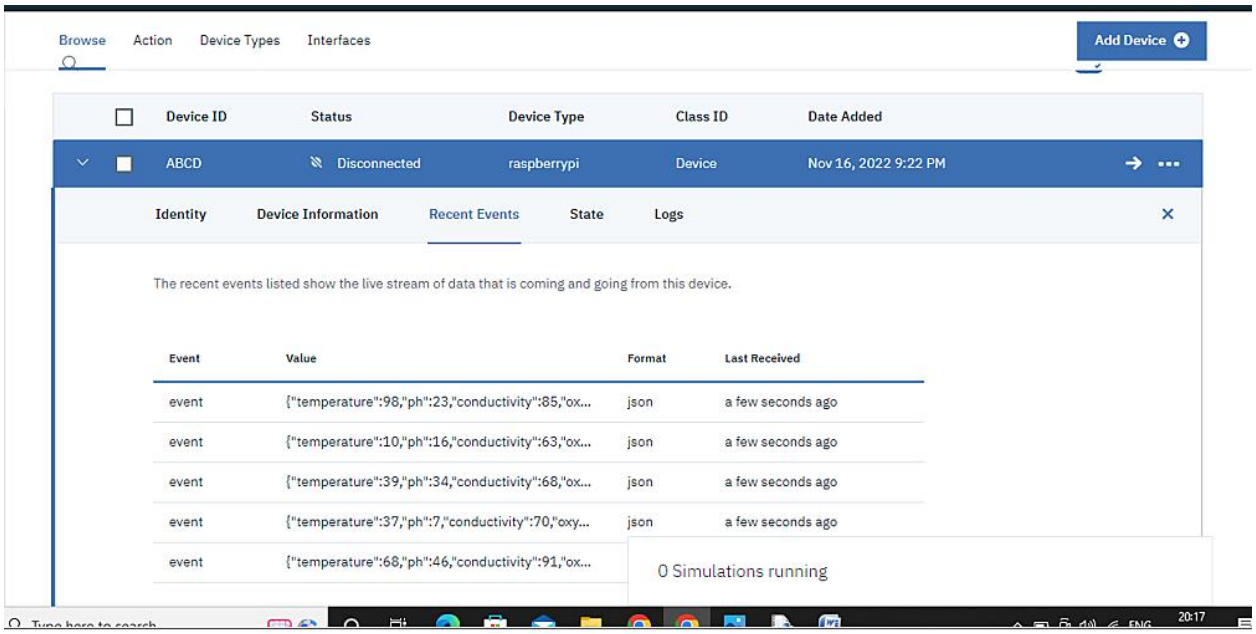


Sprint 2 - software :-

7.1.1. Create IOT device in IBM Watson IOT platform

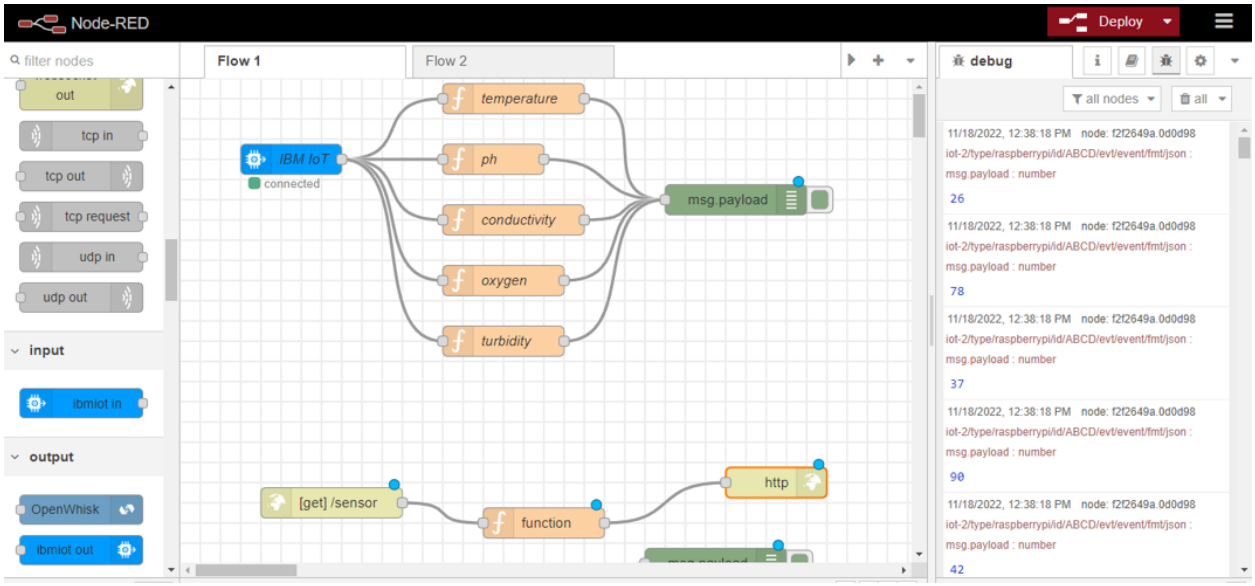


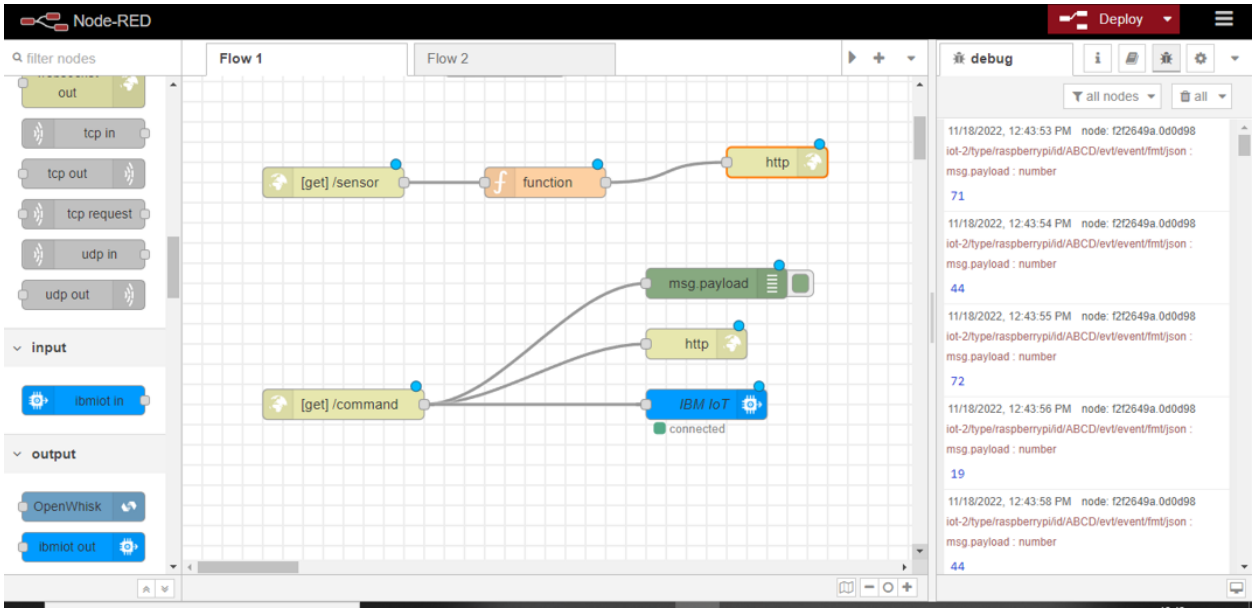
7.1.2. Device Get random sensor values from python code



7.1.3. Workflow for IOT scenarios using NODE-RED

➢ **IOT device connected to the Node-RED**



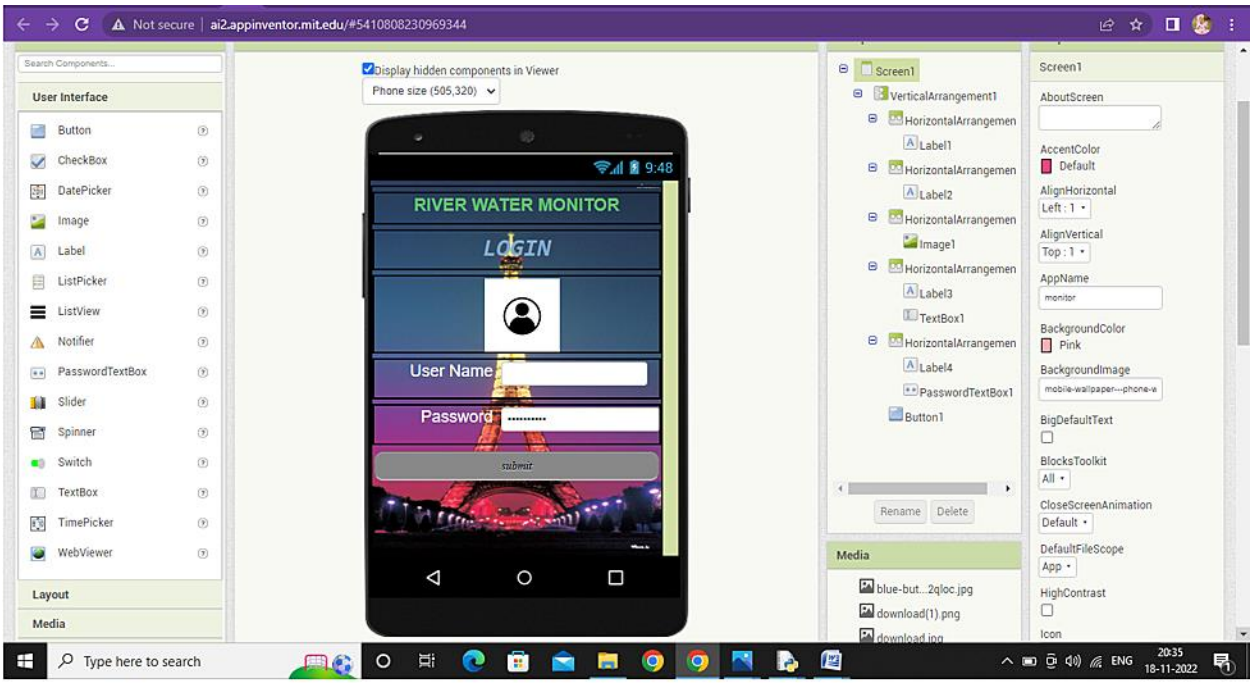


7.2. FEATURES:

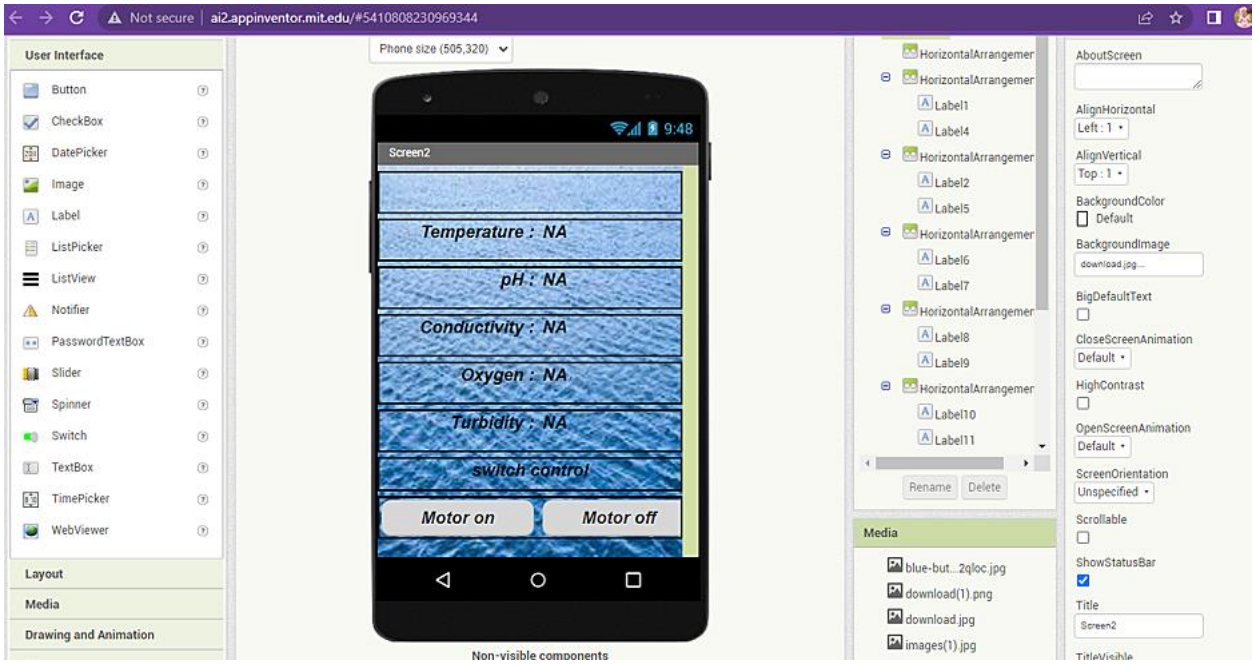
7.2.1.SPRINT 3 - BUILDING MOBILE APP

➢ **MIT App Inventor - Designer Side**

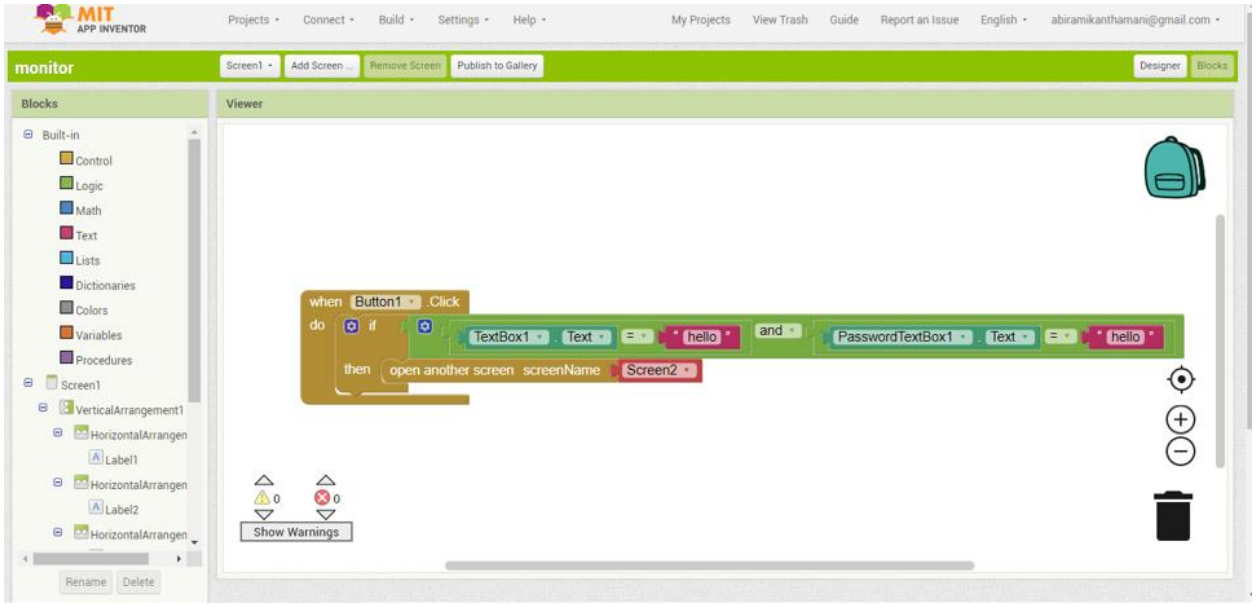
7.2.1.1. Login page :-



7.2.1.2.Design to display sensor values:

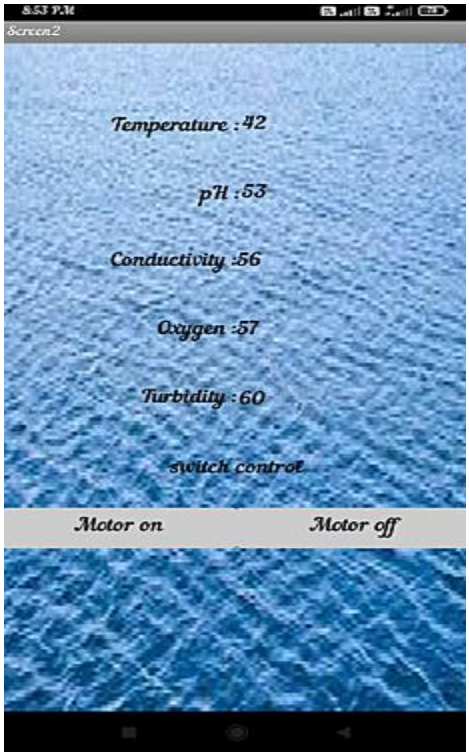


7.2.1.3. Block side:



7.2.2 SPRINT - 4 - USER INTERFACE

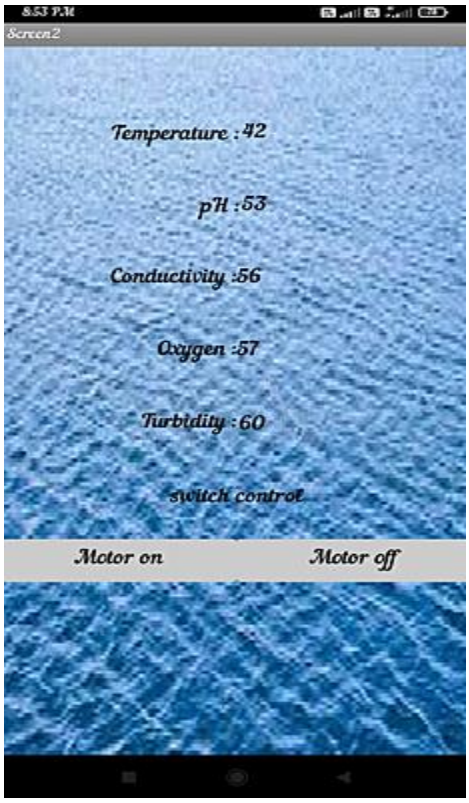

RIVER WATER MONITOR
LOGIN
User Name
hello
Password
submit


Screen2
Temperature :42
pH :53
Conductivity :56
Oxygen :57
Turbidity :60
switch control
Motor on
Motor off

8. RESULTS:

➢Performance Metrics:-

We are displaying the resulting sensed pH, temp, turbidity, and Oxygen values. It continuously senses the values of pH, temp, turbidity, and Oxygen and the resulting values are displayed to the LCD, PC or mobile in real-time.



9. ADVANTAGES:

- It is very easy to maintain the IoT based water quality monitoring systems as all the electronic boards are available in the boat itself
- The system is very cheap as the hardware and software does not cost much.
- Cloud storage platforms such as adafruit; assure helps in storing the sensor data immediately and wirelessly to the robust servers.
- Machine learning techniques have made it very easy to plot the data collected in various formats for proper analysis.

DISADVANTAGES:

- The sensors are very expansive. Moreover their maintenance cost is very high. This leads to higher cost on the regulatory body.

- The system is less effective as sensor are installed very deep inside the water and their positions are fixed
- The sensor which work on power source may often required to be replaced in case of malfunctioning.
- Mounted sensors may get damage during natural disaster and often by aquatic animals.

10.CONCLUSION:

Real-time monitoring of water quality by using IoT integrated Big Data Analytics will immensely help people to become conscious against using contaminated water as well as to stop polluting the water. The research is conducted focusing on monitoring river water quality in real-time. Therefore, IoT integrated big data analytics is appeared to be a better solution as reliability, scalability, speed, and persistence can be provided. During the project development phase an intense comparative analysis of real-time analytics technologies such as Spark streaming analysis through Spark MLlib, Deep learning neural network models, and Belief Rule Based (BRB) system will be conducted. This research would recommend conducting systematic experimentation of the proposed technologies in diverse qualities of river water.

11. FUTURE SCOPE:

Due to the limitation of the budget, we only focus on measuring the quality of river water parameters. This project can be extended into an efficient water management system of a local area. Moreover, other parameters which weren't the scope of this project such as total dissolved solid, chemical oxygen demand and dissolved oxygen can also be quantified. So the additional budget is required for further improvement of the overall system.

12. APPENDIX:

GitHub LINK:-

https://github.com/IBM-EPBL/IBM-Project-50173-1660897607.git

PROJECT DEMO LINK:-

https://youtu.be/mxHGJL7OwYk